

10/12/98 OPM NO. 5.4.11.0

DESIGN CRITERIA FOR EXPERIMENTAL FLAMMABLE GAS SYSTEMS

RHIC PROJECT

- I. The design of flammable gas systems for experimental use shall be reviewed by the Experiment Safety Committee (ESC) prior to fabrication.
- II. Distribution of flammable gas shall be armored in metal jacketed lines for fixed runs and for flexible lines up to the limiting orifice. A description of flow rates and the distribution manifold shall be provided in the design review.
- III. A proposal for the inventory of gas stored inside a building for normal (quiescent) operation shall be presented to the Experiment Safety Committee (ESC). The requested supply shall not, under any circumstance, exceed a one week supply. Depending on the volume of flammable gas proposed as storage, this amount may be reduced by the ESC. The ESC may require fill/purge volumes to be provided from bulk liquid, tube trailers, etc.
- IV. Detectors with flammable gas volumes greater than 50 ft³ or flammable gas flow rates greater than 1 ft³/hr require trained watch personnel to be present 24 hours/day.
- V. **THE DESIGN AND LOCATION OF FLAMMABLE GAS SYSTEMS**
 - A. Shall be in accordance with the attached Tables 1 and 2 from ES&H Standard 4.11.0.
 - B. Storage sites and similar places where large quantities of flammable gas are installed shall be fenced off or otherwise clearly delineated. Appropriate posting shall be placed on points of access.
 - C. If acceptable for operational reasons, outdoor locations are often safer than indoor locations; they are particularly recommended for large storage volumes.
 - D. Flammable gas systems should be located at such distances and positions with respect to intake openings for air compressors, ventilation, air conditioning, etc., so that contamination of the air throughput of such equipment is not possible.

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- E. Where there is a possibility of a major spill of flammable liquified gases, engineered protection measures, i.e. diking, diversion curbs, grading, etc., shall be installed to prevent accumulation of flammable liquid within 15 meters of any installation that represents a significant fire hazard, and infiltration of flammable gas that is heavier than air into space below grade.
- F. Outdoor weather shelters are to be provided. They shall not be enclosed by more than two walls set at a right angle. Vent spaces shall be provided between the walls and roof.
- G. The use of flammable materials within 50 feet of flammable gas storage areas shall be reviewed by the ESC.

VI. FLAMMABLE GAS DETECTION AND ALARMS

- A. The design of operational systems and indoor storage of flammable gas shall be provided to the ESC for review. It shall include an appropriate array of point detectors which alarm at the experimental operations control panel(s) and, when deemed necessary, at the Collider alarm panel in the Main Control Room. The ESC may require certain automatic functions in conjunction with alarm conditions; i.e., start of ventilation fans, electric power crash, etc.
- B. Consideration should also be given to also providing status signals to the RHIC Particle Accelerator Safety System.
- C. A minimum of two alarm set points shall be established. An emergency action level set to 25% of the LEL shall cause any preestablished automatic protection functions to actuate. These functions shall be reviewed by the ESC. The experimental group shall establish a warning level set somewhere below the emergency action level. The basis of the warning level shall be reviewed by the ESC.

VII. WINDOWS

Deviations from the following shall be approved by the ESC:

- A. Minimum thickness shall be 5 mil, with approval of the material by the ESC.
- B. The minimum strength shall be designed for 5 times the relief pressure (4 times operating) without exceeding the allowable design stress stated in ES&H Standard 1.4.2. Calculations shall be submitted to the ESC.

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- C. Consideration should be given to conducting a test with a scale model to destruction for leak and pressure at 2 times relief. The ESC shall make a determination on the need for full-scale tests to destruction.
- D. Leak and pressure testing shall be done at two times the relief value.
- E. The window deflection at relief pressure shall be such that it does not come within 2.5 cm of adjacent equipment.
- F. The test window shall be pressurized to 2.5 times the relief setting, and the deflection measured until it is constant for 4 hours. This window must then be cycled 30 times and the deflection test repeated.

VIII. PHYSICAL STRUCTURE

Deviation from the following shall be reviewed by the ESC:

- A. The enclosure shall be designed for a minimum pressure 50 times relief setting.
- B. Only commercially available fittings and feed-throughs shall be used in the construction.
- C. The design shall provide for adequate rigging, support, alignment, removal and installation of the detector or gas vessel.
- D. Ports shall be provided for complete purging of the chamber. Consideration shall be given to avoid the possibility of “dead air pockets.”
- E. Purge port location and flow direction shall take into consideration the gas density.

IX. ROUTINE OPERATIONAL TESTING

- A. The enclosure shall be leak-tight so that a point source of flammable gas leakage concentration is less than 200 ppm, at 2.5 cm from the counter surface, while the detector is pressurized 2 times the relief setting with the operational gas. Overall leakage must be diffused by building ventilation.
- B. The operational window is to be tested at 2.5 times the relief setting, cycled 3 times, with a measurement of the deflection each cycle. The deflection can be no more than 10% above the test window deflection.

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- C. The device must be leak-checked before each experimental cycle. It should satisfy condition “A” in this section.

X. ENVIRONMENT

- A. There shall be no combustible materials or ignition sources in or around the device. The layout shall be approved by the ESC.
- B. A flammable gas burn test shall be conducted on the prototype chamber to determine the area of the burn. The specifications on test conditions shall be approved by the ESC.
- C. Turn-to-turn short protection shall be provided on any associated spectrometer magnet that is in the vicinity.
- D. If vacuum windows are in close proximity to flammable gas devices they shall be pumped or purged down for 24 hours prior to introduction of flammable gas. These vacuum windows shall be classified and operated as a QA-1 device.
- E. The surrounding power and electronics shall be turned off during routine and emergency purge cycles of flammable gas.

XI. PROCEDURES

- A. An Operations Procedure shall be provided to the ESC for approval for the purge/fill and quiescent operation for all chambers containing flammable gas.
- B. The cognizant engineer shall provide alarm response procedures for shift personnel to the ESC for approval.
- C. Only personnel who are trained on the procedures shall be designated to stand watch on the system.
- D. At a minimum, notifications to the ES&H Coordinator, Main Control Room (if standing watch) and the Fire/Rescue Group shall be a stated requirement in the fill procedures. They shall be made before introduction of flammable gas in the device and after flammable gas is purged for maintenance or extended shutdown.

XII. OPERATIONAL LIMITS

- A. All flammable gas counters and systems are considered approved for five (5) calendar years after their first run, unless otherwise determined by the ESC. After this period, they must be recertified.

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- B. A summary document outlining the operational and safety envelope shall be provided for each system.

APPROVED _____
Satoshi Ozaki
RHIC Project Director

10/12/98
DATE _____

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TABLE 1

Nature of Location	Size of Flammable Gas System		
	Less Than 80 Cubic Meters	80 Cubic Meters to 420 Cubic Meters	In Excess of 420 Cubic Meters
Outdoors	First Preference	First Preference	First Preference
In a Separate Building	Second Preference	Second Preference	Second Preference
In a Special Room	Third Preference	Third Preference	Normally Not Permitted
Inside buildings not in a special room and exposed to other occupancies	Fourth Preference	Normally Not Permitted	Normally Not Permitted

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TABLE 2

Minimum Distance in Meters Without a Fire Wall

		<u>Size of Flammable Gas System</u> (m ³)		
		10 to 80	80 to 420	In Excess 420
Fire-Resistive Construction		0	0	0
Wood Frame Structures		3	8	15
Structure of Ordinary Non-Combustible Construction		0	3	8*
Wall Openings (Lighter-Than-Air Gases)	Not above any part of a system	3	3	3
	Above any part of a system	8	8	8
Wall Openings (Heavier-Than-Air Gases)	Not above any part of a system	8	8	8
	Above any part of a system	3	3	3
Flammable Liquids Above Ground	Up to 3,800 liters	3	8	8
	In excess of 3,800 liters	3	15	15
Flammable Liquids Below Ground	Up to 3,800 liters	3	3	3
	In excess of 3,800 liters	6	6	6
	Vent or fill opening of tank	8	8	8
Flammable Gas Storage	Up to 420 m ³ capacity	3	8	8
	In excess of 420 m ³ capacity	8	15	15
Oxygen Storage	Up to 340 m ³	6	6	6
	More than 340 m ³ CF	8	8	15
Fast Burning Solids, such as light lumber, excelsior, paper		15	15	15
Slow Burning Solids, such as heavy timber		3	8	15
Open Flames and Other Sources of Ignition		8	8	8
Air Compressor Intakes or Inlets to Ventilating or Air-Conditioning Equipment		15	15	15
Concentration of People**		8	8	8
Edge of Road		5	5	5

*But not less than one-half the height of adjacent side wall of the structure.

**Such as congested office areas, lunchrooms, and locker rooms.